Boulder Amateur Television Club

TV Repeater's REPEATER

January, 2024
3ed edition, issue #153

BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

Jim Andrews, KH6HTV, editor - kh6htv@arrl.net www.kh6htv.com

ATV Antennas - continued

Antenna Feed-Back: Our past several issues have been discussing antennas for ATV. It is generating interest in the ATV community and we are now getting some feed-back and additional info from ATV hams elsewhere. Keep it coming !

WA6SVT: --- Aloha Jim, Another great newsletter, thank you! On the subject of antennas: Although Comet no longer makes tri-band mobile antennas for 2 m, 70 cm and 23 cm, if you can find a used model SB-94 or SBB-94 (black). This antenna is about 20" long and works great for the entire band on both 70 cm and 23 cm. Good pattern. The 2 m side is OK but VSWR is not perfect. They also made a model SB-97 about twice as long and about 2 to 3 dB more gain.

73, Mike Collis, WA6SVT, ATN, Crestline, California

editor's note: A web search turns up details of the SB-94 at DX Engineering. But it says "no longer available". Key specs. were: Gain = 2.1dBi (2m), 5.1dBi (70cm) & 7.2dBi (23cm), 24" tall with N connector.

N0YE: -- from Don Nelson, Boulder, Colorado -- Your table in the last newsletter only reported the commercial antennas tested. Two of the home-brew, 23cm antennas which we tested on Jan. 9th were mine. I hadn't discussed the details of them with you at the time. They in fact were designed using Kent Britain, **W5VJB**, design concepts as discussed by Doug, N0NAS, in his article "Cheap ! Yagis" in the last issue #152. Rather than using wood booms, I used plastic water pipe for my booms.

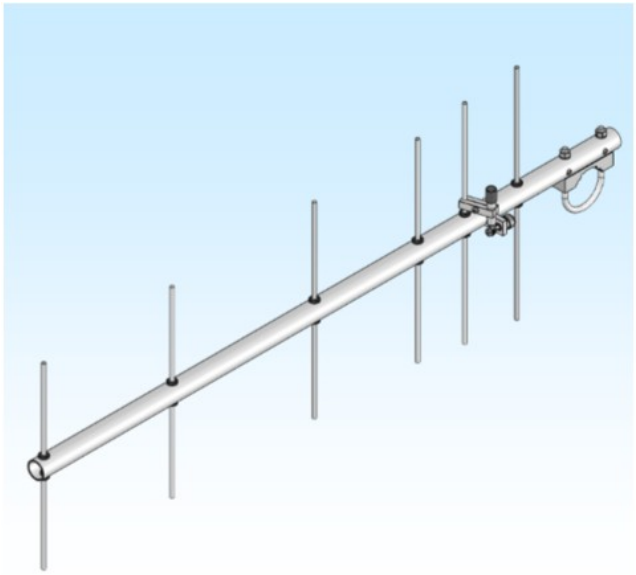
Both have the J shaped driven element. Our recent tests showed they both performed pretty well. Here is our test data:

Antenna	1243 MHz	1255 MHz	1267 MHz	1279 MHz	1291 MHz
W5VJB, 10 element Yagi	+10.6 dBi	+11.5 dBi	+10.2 dBi	+10.9 dBi	+11.0 dBi
W5VJB, 15 element Yagi	+13.0 dBi	+14.3 dBi	+13.6 dBi	+12.3 dBi	+11.3 dBi

Boulder ATV Antenna Tests - On Going:

We have recently run tests on several 23cm and 70cm antennas for possible ATV service. In the previous issue, we reported on the 23 cm test. We are holding off on reporting the full details of the 70 cm tests. *The results for the mobile antennas tested were disappointing. Since then, we have discovered that the Diamond N connector mag. mount used for the tests had an intermittent connection. Thus all mobile results reported to date are suspect.* We are now arranging to get a new mag. mount and more mobile antennas to test before we publish any results. We did get good results for the Yagi, HT and base station antennas tested. We will be releasing information in the next few newsletters about the antennas we found suitable for ATV service. We will also be noting which ones to avoid.

M-Squared Yagi Antennas



We tested two antennas from M-Squared which were very good performers for ATV service. They were very broad-band with great return loss (vswr) and flat gain across the entire 70 cm band.

The first was their 6 element, 3 ft. boom yagi, model 440-6SS. Their web site contains full details about this antenna.
https://www.m2inc.com/FG4406SS
At 3 ft. we feel this antenna is suitable for either a portable, out in the field situation or a home installation. The measured gain was relatively flat at 9 to 10.5 dBi across the whole band. A bit less than the mfgr's spec. of 11dBi.

The second antenna was their longer, 60" boom, 11 element model 420-50-11. Too big for portable use, but suitable for a home permanent installation. It was specified as 13.4 dBi gain and we measured it just 1 dB lower.

Antenna	423 MHz	429 MHz	435 MHz	441 MHz	447 MHz
M-Squared 440-6SS Yagi	+10.5 dBi	+9.7 dBi	+9.4 dBi	+9.0 dBi	+9.0 dBi
M-Squared 420-50-11 Yagi	+12.9 dBi	+12.1 dBi	+12.3 dBi	+12.1 dBi	+12.4 dBi

Return Loss: For the 440-6SS, we measured >14dB (412-451 MHz) & >10dB (409-454 MHz). For the 420-50-11, we measured >14dB (418-446 MHz) & >10dB (416-457 MHz).

Jim, KH6HTV

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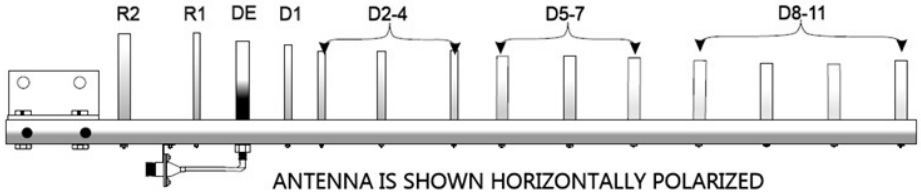
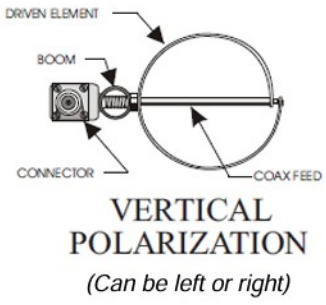
DIMENSIONS OF 1240-1285 MHz LOOP YAGI, MODEL 2414LY(K) RM



Directive Systems - 23 cm, High Gain, LOOP Yagi Antenna

The all time favorite with Boulder, Colorado ATV hams for a 23 cm base station antenna is a Loop Yagi. It is the **model DES2414LYRMK** from Directive Systems. It packs high gain in a relatively short (3 ft.) package and is broad-band. The key specs. from Directive Systems are: Gain = 15 dBi, frequency range = 1240 - 1270 MHz, 14 elements, 36" / 1" dia. boom, -3dB beamwidth (E plane) = 30°, F/B ratio = >20dB, Max. Power = 550 W average, rear mount. Price is $110.
https://directivesystems.com/1200-mhz/24-cm-1220-1285-mhz/
Note: if you instead need to work at the top end of the 23 cm band, then order their model DSE2314LYRMK. It is the same antenna, but with slightly altered dimensions to tune it to higher in the band for operation from 1270 to 1300 MHz.



Most hams are familiar with Yagi antennas built with straight rod elements mounted in the E plane. For them it is obvious then how to orient their yagi for either horizontal or vertical polarization. Not

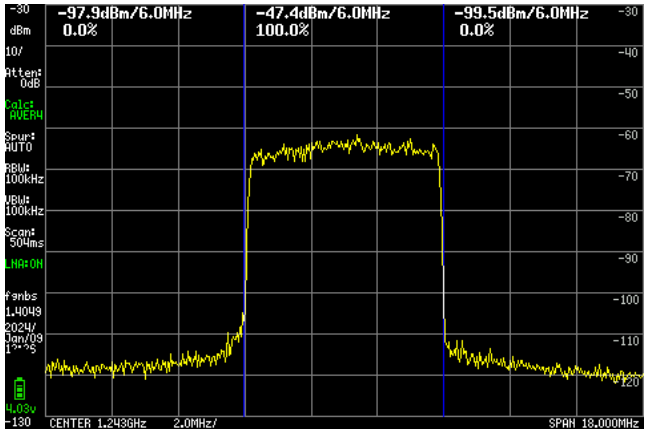
so with loop yagis. There is a lot of confusion about orientation. Here is DSE's guide line for selecting loop polarization. Their drawing is showing the driven element, also shown in the photo.

On January 9th, Don, N0YE, and Jim, KH6HTV, performed a series of antenna gain tests on 23 cm antennas, including the DSE loop yagi. It won the contest for the highest gain antenna tested. Here are our test results. They confirmed DSE's gain spec. of +15dBi.

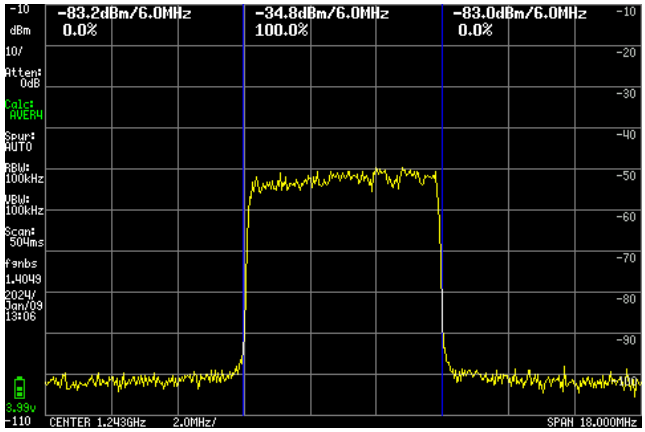
	Mfgr's Gain Spec.	1243 MHz	1255 MHz	1267 MHz	1279 MHz	1291 MHz
Directive Systems DSE2414LYRMK (loop yagi)	15dBi	14.8dBi	16.2dBi	16.9dBi	16.6dBi	15.5dBi

For the antenna gain measurements we performed them with a DVB-T video transmitter running 6 MHz BW, QPSK. The transmitter was driving an identical DSE loop yagi setup 100 yards away across a flat, clear, unobstructed RF path. The receiver was a TinySA-Ultra spectrum analyzer setup to measure the total channel power in a 6 MHz wide TV channel. With it we were able to both measure the received rf power level, but also observe the quality of the spectrum. For our reference antenna, we used a 1/4 wave ground plane (gain = +2.2dBi) mounted at the same location as the yagi antennas under test. Here are screen grabs showing the observed spectrums from both the reference antenna and the loop yagi. The reference antenna's spectrum appears to be higher than the loop yagi, but we turned off the TinySA's LNA for the stronger signal coming from the loop yagi, hence the difference. The measurement shown here was at 1243 MHz, which is the frequency we use in Boulder as the DTV input to our W0BTV repeater. At this frequency, the measured gain was thus:

Gain = -34.8dBm (loop yagi) - (-47.4dBm) (ref ant) + 2.2dBi (ref ant gain) = +14.8dBi



Reference 1/4 wave ground plane antenna
P(rf) = -47.4dBm / 6 MHz



DSE 15 element Loop Yagi antenna
P(rf) = -34.8dBm / 6 MHz

We also measured the Return Loss of the loop yagi. The min. VSWR (max. RL) was found to be -33dB at 1275 MHz. The RL was better than -14dB (1.5:1 vswr) from 1250-1290 MHz and better than -10dB (2.0:1 vswr) from 1246-1298 MHz.

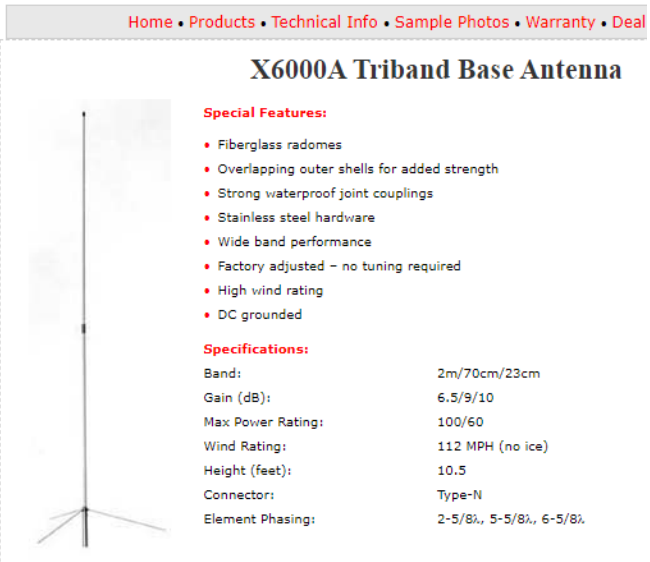
We strongly endorse the use of this Directive Systems loop yagi for 23 cm ATV service.

Jim, KH6HTV, & Don, N0YE, Boulder, Colorado

DIAMOND X6000A

We are featuring in each issue of this ATV newsletter some of the antennas which we have tested and recommend for use for ATV. In the previous issue #152, we featured the Diamond X-50. This time, we will discuss it's big brother, the X-6000, but with reservations noted.

The X-6000 is a tri-band antenna for the 2 meter, 70 cm and 23 cm bands. It is quite tall at 10' 6". It is also expensive at $200. The image shown on the right is the total information given about it by Diamond on their web site.



Diamond says the X-6000's gain is 6.5, 9 and 10 dBi respectively on the three bands.

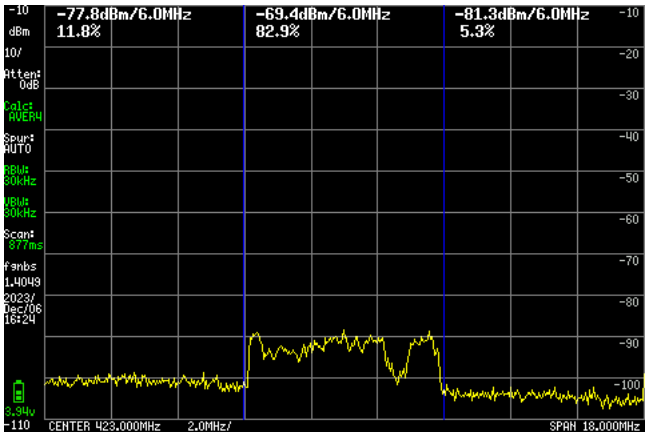
We did major antenna tests in 2011, 2017 and once again here in 2023-24. The previous tests were documented in KH6HTV application notes, AN-4 & AN-40. X-6000 was tested each time on the 70 cm band. It was tested on the 23 cm band in 2011 and again here in 2024. Similar results were obtained each time. While we got different absolute gain values (in dBi) for these antennas in different test sessions, they all definitely showed similar frequency response trends across the entire 70 and 23 cm bands. They are summarized here. The tests run in 2011 and 2017 were done using CW signal sources. Our most recent tests were performed using actual, 6 MHz, DVB-T TV signals. Thus, the most recent results are the average gain across a wide, 6 MHz TV channel.

Diamond X-6000 Gain on 70 cm Band

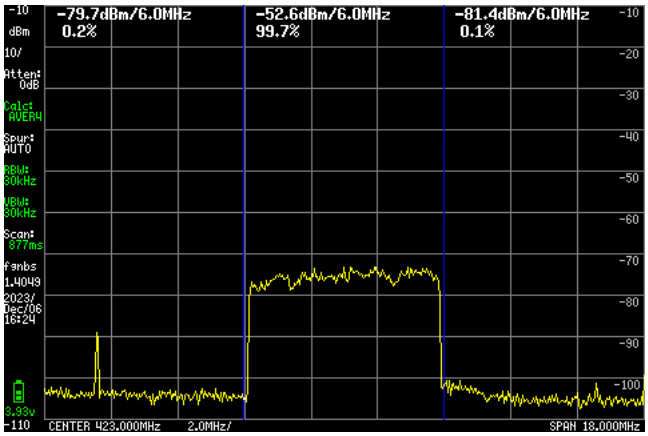
Test Date	423 MHz	429 MHz	435 MHz	441 MHz	447 MHz
2023, DVB-T	***-5.6 dBi***	***-2.4 dBi***	+1.9 dBi	+6.1 dBi	+9.2 dBi
2011, CW	1.3 dBi (421.25)	4.3 dBi (427.25)	4.7 dBi (433.25)	6.5 dBi (439.25)	10.7 dBi (445.25)

Diamond X-6000 Gain on 23 cm Band

Test Date	1243 MHz	1255 MHz	1267 MHz	1279 MHz	1291 MHz
2024, DVB-T	8.2 dBi	7.1 dBi	6.6 dBi	6.0 dBi	4.0 dBi
2011, CW	7 dBi (1247 MHz)		7 dBi (1277 MHz)		8 dBi (1292 MHz)



X-6000 antenna



X-50 antenna

These spectrum plots show the dramatic loss in gain of the X-6000 at the bottom end of the 70cm band comparing it to it's little brother, the X-50. They were measured using the W0BTV repeater's signal on 423 MHz from a distance of 13 miles away. Note the difference in the received 6 MHz ATV channel powers of -52.6dBm (X50) vs. -69.4dBm (X6000).

X-6000 Return Loss: On the 70cm band we measured >14dB (434-452 MHz) and >10dB (423-455 MHz). On the 23 cm band, we measured >14dB (1285-1310 MHz) and >10dB (1263-1288 MHz). Return Loss is the same as measuring VSWR, just expressed differently. For comparison to vswr --- -14 dB RL ==> 1.5:1 vswr, -10 dB RL ==> 2.0:1 vswr, & -6 dB RL ==> 3.0:1 vswr.

The **Diamond X-6000** It is big at 10.5 ft. tall. It works on three bands, 2 m, 70 cm & 23 cm. But it should never be used lower than the top 10 MHz of the 70 cm band. It's gain totally "SUCKS" lower in the 70 cm band. We even saw negative gains below 430 MHz. It does meet Diamond's spec. at the top end of the band. On the 23 cm band it's gain is lower than spec. and favors the lower portion of the band. The only reason to ever want to use it for ATV service would be for an ATV repeater which also needs to have both 70 cm & 23 cm inputs. But then only for a 70 cm input above 440 MHz. The Boulder W0BTV, ATV repeater does use the X-6000 for 2 m control, 70 cm (441 MHz) input and 23 cm (1243 MHz) input. At our repeater site, we were allowed to only put up one receive antenna. The X-6000 gets the ***"Do Not Buy"*** award except for special ATV situations requiring operation on both 70 and 23 cm bands. If you have the tower space available for your repeater antennas, then do not use the X-6000, but separate antennas for each band. However, if you are looking for an antenna for FM voice service, then you might very well want to buy the X-6000 for it's tri-band capabilities.

---- Jim, KH6HTV, Boulder, Colorado

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HT Hand-Held Whip Antennas

We found two excellent HT whip antennas for ATV service also. **Diamond SRH999** is the overall winner. It's key selling factor is it is a good, multi-band (2m/70cm/23cm) flexible whip antenna. It's 70 cm gain was +1.5 to +2 dBi. It also showed good performance on the 23 cm band with gains ranging from +3 to +6 dBi. It is 19.5" tall and sells for $55.

https://www.diamondantenna.net/srh999.html

The Chinese **Bingfu BFN00606**, came in second place. It is only usable on the 70 cm band. It has low vswr and good gain of +1.5 to +3 dBi across the whole 70cm band plus very low cost. It is sold by Amazon Prime in a package of two for only $15. We also tested a very similar appearing, quite popular, **Nagoya NA771** and found it to have very poor performance. The Nagoya NA771 rated a **"Do Not Buy"** award. --- Jim, KH6HTV

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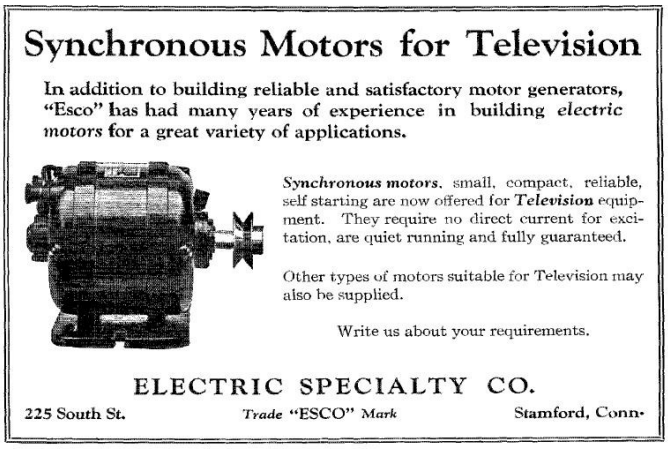


Synchronous Motors for Television

In addition to building reliable and satisfactory motor generators, "Esco" has had many years of experience in building *electric motors* for a great variety of applications.

Synchronous motors, small, compact, reliable, self starting are now offered for *Television* equipment. They require no direct current for excitation, are quiet running and fully guaranteed.

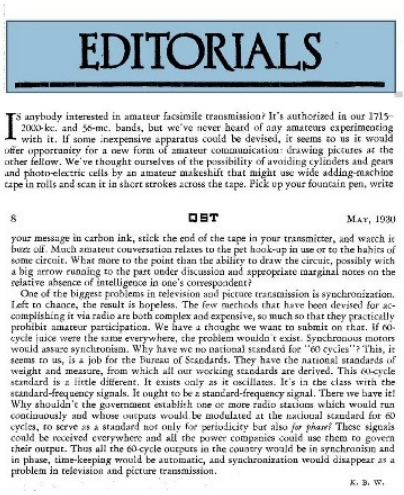
Other types of motors suitable for Television may also be supplied.

Write us about your requirements.

ELECTRIC SPECIALTY CO.

225 South St. *Trade* "ESCO" *Mark* Stamford, Conn.

1928 QST



EDITORIALS

Is anybody interested in amateur facsimile transmission? It's authorized in our 1715-2000-kc. and 56-mc. bands, but we've never heard of any amateurs experimenting with it. If some inexpensive apparatus could be devised, it seems to us it would offer opportunity for a new form of amateur communication: drawing pictures at the other fellow. We've thought ourselves of the possibility of avoiding cylinders and gears and photo-electric cells by an amateur makeshift that might use wide adding-machine tape in rolls and scan it in short strokes across the tape. Pick up your fountain pen, write

8 QST MAY, 1930

your message in carbon ink, stick the end of the tape in your transmitter, and watch it burn off. Much amateur conversation relates to the pet hook-up in use or to the habits of some circuit. What more to the point than the ability to draw the circuit, possibly with a big arrow running to the part under discussion and appropriate marginal notes on the relative absence of intelligence in one's correspondent?

One of the biggest problems in television and picture transmission is synchronization. Left to chance, the result is hopeless. The few methods that have been devised for accomplishing it via radio are both complex and expensive, so much so that they practically prohibit amateur participation. We have a thought we want to submit on that. If 60-cycle juice were the same everywhere, the problem wouldn't exist. Synchronous motors would assure synchronism. Why have we no national standard for "60 cycles"? This, it seems to us, is a job for the Bureau of Standards. They have the national standards of weight and measure, from which all our working standards are derived. This 60-cycle standard is a little different. It exists only as it oscillates. It's in the class with the standard-frequency signals. It ought to be a standard-frequency signal. There we have it! Why shouldn't the government establish one or more radio stations which would run continuously and whose outputs would be modulated at the national standard for 60 cycles, to serve as a standard not only for periodicity but also *for phase*? These signals could be received everywhere and all the power companies could use them to govern their output. Thus all the 60-cycle outputs in the country would be in synchronism and in phase, time-keeping would be automatic, and synchronization would disappear as a problem in television and picture transmission.

K. B. W.

1930 QST

ATV in QST - almost 100 years ago !

Skip, K1NKR has just sent us this find from old QSTs --- "Hi Jim. I'm still enjoying your newsletters. You're doing a great service to the community.

One of the things I've taken on recently is accumulating a history of the conventions held by the ARRL New England Division. This year will be our hundredth anniversary. Not 100 conventions, but 100 years of conventions. We're on a big expansion campaign, considering we're the only major convention east of Dayton and north of DC. (***https://hamxposition.org/***)

I gave a very elementary talk on our image modes to my local club and last year's convention. In preparing for it, I realized just how early interest in television came to the Amateur community. Note the attached May 1930 editorial.

While scanning through old QSTs for the history project, I also came across an advertisement from 1928 for synchronous motors for use in television--obviously Amateur television because why else would the ad be there in our magazine? Wow, 1928! There were even technical talks in the various conventions of that era. Thought you and your readers might be interested.

73, Skip Youngberg, K1NKR, Malborough, MA

Text of above ATV article - May, 1930 QST --- EDITORIALS

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More About the Early Years of Television

In preparing previous talks about ATV, I did some digging into the old history of TV and came across some other interesting tidbits of info. I developed this TV Time-Line for my talks. -- Jim, KH6HTV

1925 -- QST reports on TV experiments using mechanical scanning
1926 -- John Blair in Scotland demonstrates the first working TV using mechanical scanning.
1927 -- Philo Farnsworth, gets first patent for all electronic scanned TV system
1929 -- First TV broadcast by BBC in London
1939 -- First live TV broadcast in USA by NBS in New York City
1940 -- First ham TV, two way QSO. In New York City between W2USA and W2DKJ, duplex on 56 and 112 MHz.
1941 -- FCC issues the NTSC standard. Standard is etched into stone and last for over 60 years.
1941-45 -- WWII, TV development suspended
1946-50 -- Major deployment of broadcast TV stations in all major metro areas.
1948 -- San Francisco bay area hams are transmitting NTSC TV on the 70cm band.
1950 -- Ed Tilton in June issue of QST reports on major ham TV activity in USA, UK, and Holland
1953 -- Color added to TV, compatible with B&W -- only major change to NTSC
1957 -- Cop McDonald, VY2CM, develops slow-scan TV for use on HF.

1968 -- Japan starts analog HDTV development
1986 -- USA & Europe turn down Japan's proposal for their analog HDTV system
1987 -- FCC creates the ATSC to develop digital TV
1991 -- DVB development starts in Europe
1991-92 -- FCC holds field trials for competing digital and analog HDTV systems
1993 -- MPEG-2 video encoding standard adopted
1993 -- Europe selects DVB as their DTV system
1996 -- FCC selects ATSC's 8-VSB system for broadcast DTV in the USA with 10 year transition period from analog to digital.
1999 -- Sinclair Broadcasting challenges selection of 8-VSB over DVB-T. Field tests show superiority of DVB-T for indoor reception with simple antennas. FCC turns down petition.
2009 -- USA switches completely from analog TV to DTV (8-VSB)
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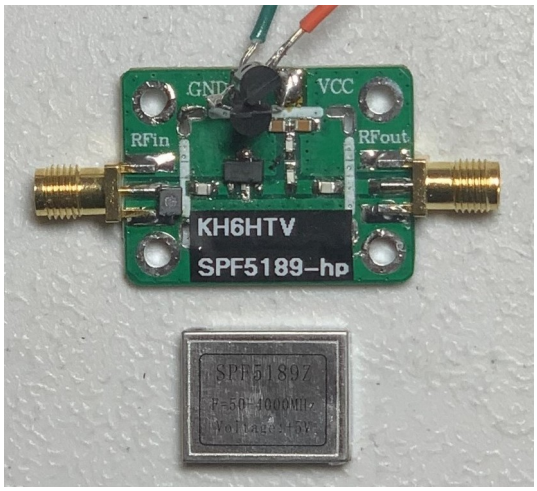
A Cheap 2.4GHz Pre-Amp

Jim, KH6HTV

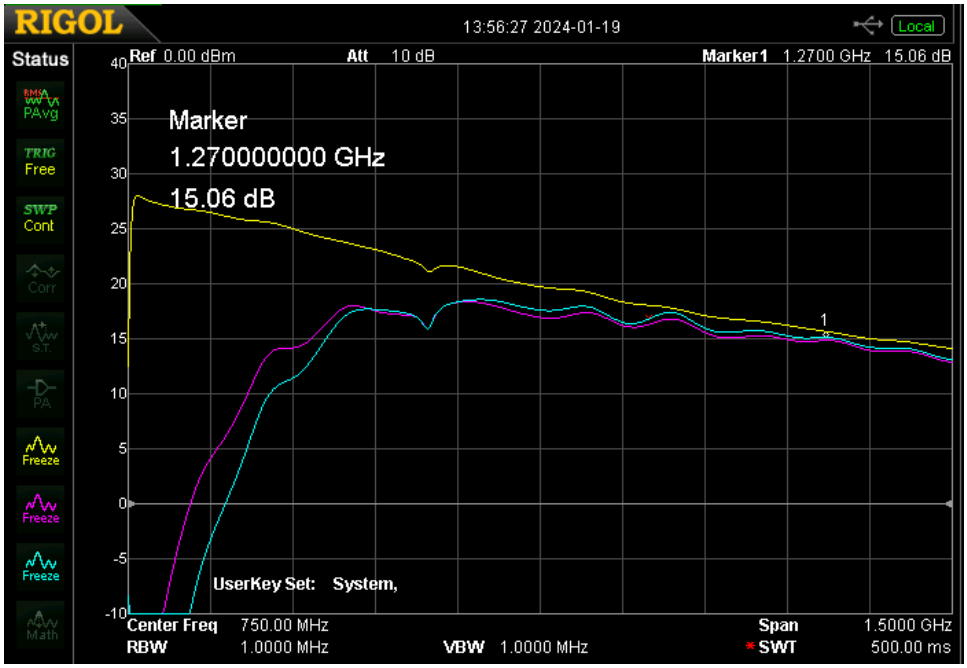


Some of the Boulder ATV hams have gotten the microwave DATV itch again. So time to blow off the dust of our gear. On item I needed for my 2.4 GHz down-converter set-up was a pre-amp to go in front of the mixer.

Many hams today are using the SPF5189, lo-noise MMIC for their pre-amps. A quick google search on the web will come up with a very inexpensive ($10) Chinese pre-amp pc board with the SPF5189. Available from Amazon & E-Bay

The SPF5189 has very complete specs. from RFMD for operation at 900 and 1900 MHz. There they say the gain and noise figure is 19dB / 0.55dB (900MHz) and 13dB / 0.8dB (1900MHz). But elsewhere on the spec. sheet they say it is useful from 50 MHz to 4 GHz. The gain is definitely not flat over this range. 30dB at 50 MHz falling to 8dB at 4 GHz. It is typically powered with +5Vdc and draws 90mA.

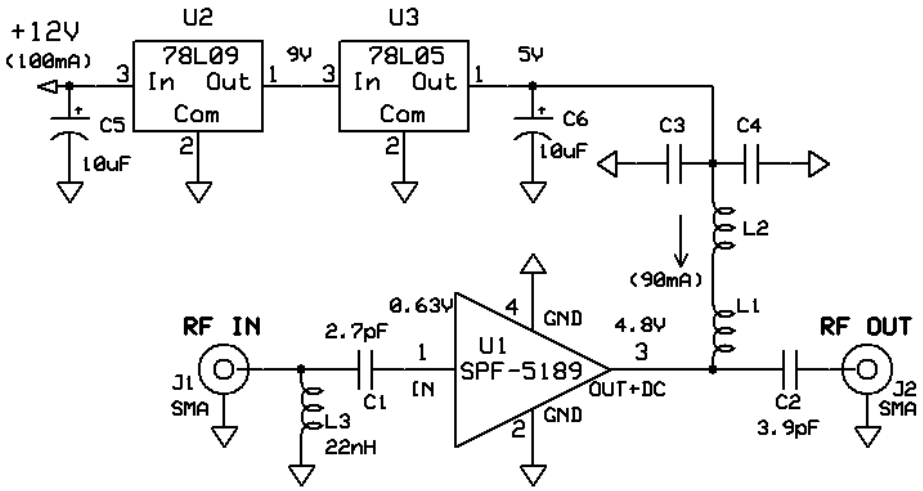
However, I have found a lot of times buying these really inexpensive pc board amps from China that they are not using first rate semiconductors. They are keeping their costs down by using factory rejects, floor-sweepings probably. Such was the case with the SPF5189 amps I purchased. My first indication was when I powered them up with +5Vdc, and they pulled 150mA, far in excess of the spec. 90mA. Plus, a test of the Chinese amp's gain showed it to be too low. So my first modification was to rip out the IC from the pcb and replace it with a known, good one. Now, it pulls 90mA per spec. Even replacing the IC, $10 was a good price to pay to get a nice, little pc board complete with SMA connectors.



SPF5189 Pre-Amp, S21 Gain vs. Frequency: sweep from 0 to 1.5GHz, 5dB/div & 150MHz/div
Yellow trace is unmodified amp. Magenta trace is with smaller in/out capacitors. Cyan trace is with added shunt inductor.

A swept frequency S21, gain test using my Rigol spectrum analyzer and tracking generator confirmed that the gain vs. frequency is far from flat and is very high at low frequencies. I only wanted a pre-amp for 2.4 GHz. Having such high gain at lower frequencies could lead to potential problems with overloading, inter-mod, etc. from other signal sources. So my next modification was add a high-pass filter. I did this by replacing both the input and output dc blocking capacitors with much smaller ones. (C1 = 2.7pF & C2 = 3.9pF). They need to be 0805 SMD size. I also added a shunt SMD inductor on the rf input. (L3 = 22nH). The results are shown above. While we still have appreciable gain above 500 MHz, the low frequencies are now severely attenuated without adding much loss to the input to the MMIC. I did a CW measurement of the gain at 2.4 GHz and found it to be +10.5 dB.

My next modification was to change the DC power input. The basic pc board is setup to be powered with +5Vdc. I wanted to operate it from +12Vdc instead. So, I simply added using "ugly wiring" a 78L09 (9V) and 78L05 (5V) voltage regulators in series. Why both ? Because U1 pulls 90mA, if I dropped 13.8 to 5V thru a single 78LXX regulator, I would exceed it's max. power rating. Using two in series was cheap, simple and kept the power dissipation on each within limits. Below is the schematic diagram of my modified SPF5189 pre-amp.



Modified SPF-5189, 2.4 GHz Pre-Amp schematic

W0BTV Details:

Inputs: 23 cm Primary (CCARC co-ordinated) + 70 cm secondary all digital using European Broadcast TV standard, DVB-T 23cm, 1243 MHz/6 MHz BW (primary), plus 70cm (secondary) on 441 MHz with 2 receivers of 6 & 2 MHz BW
Outputs: 70 cm Primary (CCARC co-ordinated), Channel 57 -- 423 MHz/6 MHz BW, DVB-T Also, secondary analog, NTSC, FM-TV output on 5.905 GHz (24/7 microwave beacon).
Operational details in AN-51c Technical details in AN-53c. Available at: ***https://kh6htv.com/application-notes/***

W0BTV ATV Net:

We hold a social ATV net on Thursday afternoon at 3 pm local Mountain time (22:00 UTC). The net typically runs for 1 to 1 1/2 hours. A DVD ham travelogue is usually played for about one hour before and 1/2 hour after the formal net. ATV nets are streamed live using the British Amateur TV Club's server, via: ***https://batc.org.uk/live/*** Select ***ab0my or n0ye***. We use the Boulder ARES (BCARES) 2 meter FM voice repeater for intercom. 146.760 MHz *(-600 kHz, 100 Hz PL tone required to access*).

Newsletter Details:

This is a free newsletter distributed electronically via e-mail to ATV hams. The distribution list has now grown to over 500+. News and articles from other ATV groups are welcomed. Permission is granted to re-distribute it and also to re-print articles, as long as you acknowledge the source. All past issues are archived at: **https://kh6htv.com/newsletter/**

ATV HAM ADS -- *Free advertising space is offered here to ATV hams, ham clubs or ARES groups. List here amateur radio & TV gear*

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